Department of Chemistry: Assessment & Improvement Report 2012-2013

Assessment Coordinator: Emily Borda

Departmental Mission: The chemistry department contributes to Western Washington University’s mission by fostering lifelong learning in the chemical and biochemical sciences through exceptional classroom, laboratory, and research experiences. Students participating in our program will master content and develop critical thinking and communication skills that will help them be scientifically literate citizens and prepare them for professional careers as scientists, educators, and health professionals. Chemistry students, faculty and staff contribute to the scientific enterprise and broader community through outreach and a program of student-focused scholarship and research that strives to be the strongest of its kind in the nation.

Departmental Student Learning Outcomes: Upon graduation, majors will be able to
1. Understand and integrate fundamental chemical principles that unify all traditional and emerging areas of chemistry and biochemistry including:
   a. atomic theory
   b. molecular structure and bonding
   c. physical properties of molecules
   d. kinetics, thermodynamics and equilibrium
   e. reaction mechanisms
   f. chemical synthesis
2. Acquire detailed, in-depth knowledge from the traditional and emerging areas of chemistry and biochemistry and be able to integrate and apply these principles to solve complex scientific problems.
3. Acquire laboratory skills necessary to answer questions of chemical relevance, including:
   a. Understanding and demonstrating safe and effective laboratory practices.
   b. Understanding the theory behind and being able to interpret data generated by a variety of chemical instruments.
   c. Interpreting experimentally-generated data to reach a sound conclusion.
   d. Designing an experiment to answer a scientific question.
4. Connect the theory they learn in class with the experiments and procedures they perform in the lab.
5. Be able to critically analyze chemistry-related claims and connect chemistry-related ideas to everyday and societal contexts.
6. Develop effective quantitative reasoning skills.
7. Effectively communicate scientific information in written and oral forms.
8. Use primary literature to further their knowledge of advances in the fields of chemistry and biochemistry.
9. Work both individually and collaboratively with peers to advance the skills outlined above.

GUR Learning Outcomes:
1. Analyze and communicate ideas effectively in oral, written, and visual forms
3. Use quantitative and scientific reasoning to frame and solve problems
**Student Learning Objectives Assessed:**

<table>
<thead>
<tr>
<th>Assessment Measures</th>
<th>SLO's Assessed</th>
<th>Results</th>
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<tr>
<td>Online HW questions from general chemistry</td>
<td>1, 6, GUR comp. 3</td>
<td>We tracked pre- and post-instruction scores on selected questions in four 96-student classes of chem 121 (general chemistry I) during spring quarter 2013, and matched these scores to the SLO they assessed: either sub-components of SLO 1 (a-c are the only elements of SLO 1 taught in Chem 121) or to SLO 6. The average gain (post-pre) scores on individual questions varied widely, and no overall trends were observed that pointed to one sub-component of SLO 1 or to SLO 6 in particular as needing further focus. However, we did observe from the pre-assessment that students, most of whom have taken high school chemistry, tend to come in with weak understandings in certain areas of atomic structure, classification of chemical vs. physical changes, and classification of bond types. Students also made large gains in most of these areas over the course of the quarter. Post-assessment results further revealed that the most troublesome questions for students tended to use molecular (e.g. pictures of atoms or molecules) instead of symbolic (e.g. formulas or equations) representations.</td>
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<td>Writing samples from WP courses + debriefing</td>
<td>7, GUR comp. 1</td>
<td>We are still awaiting the availability of writing samples from spring quarter WP classes and will analyze these data in July and send them to CUE chair before fall quarter.</td>
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**Example(s) of Changes Based on Assessment**

The most chem 121 courses are offered during fall quarter. Therefore, chemistry instructors will meet at the beginning of fall quarter and discuss how they can make more room in the curriculum to teach atomic structure, classification of chemical vs. physical changes, and classification of bond types. Instructors will use preassessment data to identify areas where students have stronger understanding coming from high school, and can thus decrease the amount of time spent in these areas.

We believe the challenge in the molecular representation questions comes from students’ difficulty translating what they learn in class, mostly through symbolic representations, into submicroscopic models of what those representations actually mean. This lack of translation points toward a possible lack of strong conceptual understanding among students. Chemistry instructors will discuss how molecular and atomic representations can be further integrated into daily classroom sessions, for example by drawing them beside equations on the board, using simulations, or by other means.